

Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, DC 20554

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FEDERAL COMMUNICATIONS COMMISSION  
OFFICE OF THE SECRETARY

In the Matter of )  
 )  
Petition of the Intelligent )  
Transportation Society of )  
America for Amendment of the )  
Commission's Rules To Add )  
Intelligent Transportation )  
Services (ITS) as a New Mobile )  
Service With Co-Primary Status )  
in the 5.850 to 5.925 GHz Band )

RM-9096

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REPLY COMMENTS

The Cellular Phone Taskforce hereby replies to the initial comments filed in the above-captioned proceeding. The Taskforce opposes the allocation of frequencies for use in Intelligent Transportation Services (ITS), and believes it is not in the public's interest, nor in the interest of an unpolluted environment, to facilitate the use of Dedicated Short Range Communication ("DSRC") based systems along the nation's highways, contrary to the assertions of most of the commenters.

1. Statement of Interest

The Cellular Phone Taskforce is comprised partially of citizens who are already suffering serious illness, or have lost their homes, or have had to move away from their place of residence, because of microwave radiation from wireless communications technology installed in their vicinity during the past nine months. Some of our members have died because

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of continuing involuntary exposure to such radiation. A review of the scientific literature on exposure to microwaves at power densities of from .0000000026 microwatts per square centimeter to 500 microwatts per square centimeter ( $\mu\text{W}/\text{cm}^2$ ) indicates overwhelmingly that, contrary to the Commission's safety guidelines established August 6, 1996, such radiation is extremely injurious to life.<sup>1</sup> The large majority of

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<sup>1</sup>  $0.6 \mu\text{W}/\text{cm}^2$  at 1425 MHz can cause arrhythmias or even stop the heart: Frey, A.H. and Seifer, E. Pulse modulated UHF energy illumination of the heart associated with change in heart rate. Life Sciences 7(Part II):505-512, 1968.

$10 \mu\text{W}/\text{cm}^2$  impairs memory and visual reaction time: Chiang et al. Health effects of environmental electromagnetic fields. Journal of Bioelectricity 8(1):127-131, 1989.

Less than  $0.1 \mu\text{W}/\text{cm}^2$  is enough to impair motor function, reaction time, memory and attention: Kolodynski, A.A. and Kolodynska, V.V. Motor and psychological functions of school children living in the area of the Skrunda Radio Location Station in Latvia. The Science of the Total Environment 180:87-93, 1996.

Chronic exposure produces changes in brain waves similar to those seen in epileptic seizures: Klimkova-Deutschova, E. Neurologic findings in persons exposed to microwaves. Biologic Effects and Health Hazards of Microwave Radiation: Proceedings of an International Symposium, Warsaw, 1973, P. Czerski et al., eds., pp. 268-272.

Garaj-Vrhovac et al. write that microwave radiation is "a known mutagenic agent": Garaj-Vrhovac, V. et al. Somatic mutations in persons occupationally exposed to microwave radiation. Mutation Research 181:321, 1987.

Balcer-Kubiczek proved microwaves are carcinogenic, using 2.45 GHz pulsed waves at 0.1 W/kg: Balcer-Kubiczek, E.K. Experimental studies of electromagnetic field-induced carcinogenesis in cultured mammalian cells. In On the Nature of Electromagnetic Field Interactions with Biological Systems, A.H. Frey, ed., 1994, pp. 143-155.

$0.00000002 \mu\text{W}/\text{cm}^2$  at 6 GHz has hormonal effects: Kondra, P.A. et al. Growth and reproduction of chickens subjected to

scientific studies upon which the Commission's guidelines were based were acute exposure studies to power densities of 1 milliwatt per square centimeter or more.<sup>2</sup> Nobody ever did an adequate review of the literature on lower exposure levels until November 1996. Such a review is now available (Microwaving Our Planet: The Environmental Impact of the Wireless Revolution, Arthur Firstenberg, 1997, second edition, 92 pages, published by the Cellular Phone Taskforce).<sup>3</sup> It is already well known in the case of ionizing radiation, and in the case of toxic or carcinogenic chemicals, that exposure to high levels produces different experimental results altogether than exposure to low levels. There is therefore no reason to suppose that the thousands of acute exposure studies in the case of microwaves at levels of 1 milliwatt per square centimeter or more have any bearing whatever on the safety of

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microwave radiation. Canadian Journal of Animal Science 50:639-644, 1970.

0.0000000026 uW/cm<sup>2</sup> at 30 MHz affects cell division: Marha, K., pp. 188-191 in Symposium Proceedings. Biological Effects and Health Implications of Microwave Radiation, S. Cleary, ed., Richmond, Va., 1969.

A complete bibliography, with 232 entries, is included in Appendix A.

<sup>2</sup> IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, IEEE C95.1-1991. Also NCRP, Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields, Report #86, April 2, 1986.

<sup>3</sup> The first edition of Microwaving Our Planet is attached as Appendix A. The second edition will be available approximately August 20, 1997.

chronic exposure to much smaller levels of microwaves. No such link has ever been established.<sup>4</sup> Indeed, the several hundred scientific studies reviewed in Microwaving Our Planet show serious damage to all cells and organs of the body at exposure levels four and five orders of magnitude less than permitted by the Commission's current guidelines.

The members, and other interested parties, represented by the Cellular Phone Taskforce, now number in the thousands and live in all parts of the United States. We are no different from anybody else except perhaps that we are suffering more intensely or that we are more aware of the cause of our suffering. There is ample scientific evidence available now that the widespread epidemic of insomnia, eye problems, and neurological and cardiac symptoms<sup>5</sup> in the coverage areas of the new personal communications services (PCS) systems is due to the microwave radiation now blanket-ing such areas.<sup>6</sup> It is already difficult for those of us who

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<sup>4</sup> "The FCC does not claim that their new exposure guidelines provide protection for effects to which the 4W/kg SAR basis does not apply. . . Both the NCRP and ANSI/IEEE standards are thermally based, and do not apply to chronic, nonthermal exposure situations." — Norbert Hankin, Office of Radiation and Indoor Air, Environmental Protection Agency, Oct. 8, 1996. Mr. Hankin's letter is attached as Appendix B.

<sup>5</sup> The Cellular Phone Taskforce has received reports of such problems from approximately 700 individuals, physicians, nurses, and organizations nationwide. We field 30-40 such phone calls each week. Further information about these is available if the Commission requests it.

<sup>6</sup> See, for example, Abelin, T. et al., Study on Health Effects of the Shortwave Transmitter Station of Schwarzenburg, Bern, Switzerland, Study No. 55, Aug. 1995, Swiss Federal Office of

are sickest or most sensitive to the radiation to find safe places to live. If the technology envisioned by the Intelligent Transportation Society of America (ITS America) is put in place throughout the United States, we will not even be able to look for safe places to live, because we will no longer be able to travel on the nation's highways.

The extent of support for ITS America's petition, not only by manufacturers of DSRC devices, but by associations of truckers, toll authorities, and automobile manufacturers, and by the U.S. Dept. of Transportation, as indicated in their several Comments, causes grave concern on the part of those members of the Taskforce who are already ill or disabled by microwave radiation sickness.

## 2. Reply to Comments of Mark IV Industries

As noted by this commenter, "the implementation of short-range LMS systems has grown substantially so that today most major U.S. toll highway, tunnel and bridges systems. . . have short-range 902-928 MHz LMS systems or are planning to implement such systems in the near future." Mark IV's comments further state that the public benefits from all this. As an organization representing a segment of the public, the Cellular Phone Taskforce respectfully disagrees. Our members have been injured by all of this, and many of us can no longer travel on

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Energy. The documented symptoms were substantially the same. Exposure levels in the study were as little as  $.054 \text{ uW/cm}^2$ .

toll roads at all because of technology installed by this company and others. The presence of microwave beacons at intervals along the highway is in fact dangerous. Its impact on the nervous system of drivers is possibly worse than the impact of alcohol, and will cause accidents. This radiation can trigger seizures and heart arrhythmias, and impair motor function, reaction time, memory and attention, as noted above (footnote 1), and should never be allowed to impact a highway where people are driving.

Mark IV's technology in particular is a worse health hazard than that of other manufacturers because its antennas are being installed invisibly underneath the pavement so that sensitive people who must avoid radiation do not even know it is there.

### 3. Reply to Comments of Management Systems Council ("MSC")

MSC and the American Trucking Associations ("ATA") support the increased allocation of spectrum for DSRC systems utilization. The Cellular Phone Taskforce disagrees with MSC that such increased utilization will improve motor carrier services and increase profits. Among the members of the Taskforce are several truckers who are being increasingly disabled by microwave radiation along their routes. They have had their eyes swelled shut for periods of time and been unable to work. They cannot drive as many hours as before along certain routes without sleeping. The acceleration of this trend will greatly harm the trucking industry of the United States.

4. Reply to Comments of Minnesota Mining and Manufacturing Co.  
("3M")

3M states that advanced data transmission systems "will provide for more safe and efficient transportation." The Taskforce reiterates that, as these systems are a health hazard, and interfere with the nervous system severely, and cause seizures and heart arrhythmias in healthy people, they will most certainly not provide for either safety or efficiency. They will also not, as 3M states, reduce highway fatalities, but will instead cause more. And they will not cause reduced pollution, but will add yet another form of invisible pollution.

5. Reply to Comments of Resound Corporation and The American Radio Relay League, Inc.

These two commenters oppose ITS America's petition to the extent it will cause interference with other uses of the same or nearby spectrum. Resound Corp. is concerned with its own planned use of the 5.850-5.875 GHz band for hearing aids. And the American Radio Relay League is concerned about interference with amateur uses of the same or nearby bands.


The Cellular Phone Taskforce's position is that the most important system that must not be interfered with is the human body, and that health considerations must take precedence over highways, hearing aids, and amateur uses of this spectrum alike. We concur with the American Radio Relay League and Resound Corp. in urging the Commission to tread much more cautiously in furthering innumerable uses for wireless technology, and

we urge them to join the Taskforce in putting human and environmental health first in designing highways.

6. Conclusion

The Cellular Phone Taskforce filed a Petition for Reconsideration on August 30, 1996 in the matter of Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation (ET Docket No. 93-62 and FCC Report and Order FCC 96-326). The issues addressed by the Taskforce have not yet been resolved. The Cellular Phone Taskforce respectfully requests the Commission not to allocate spectrum for uses that will impact the environment of the United States in such an enormous way. The testimony of so many people that they are already being seriously injured must not be ignored any longer.

Respectuflly submitted,

  
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August 9, 1997



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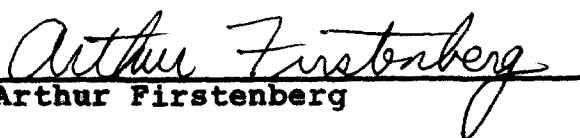
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## **APPENDIX A**

### **MICROWAVING OUR PLANET**

**The Environmental Impact of  
the Wireless Revolution**

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# MICROWAVING OUR PLANET

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# 1 Microwaving Our Planet

## Introduction

From Bill Gates' planned fleet of 924 satellites to the millions of ground based antennas being constructed throughout the world, our privacy is being invaded, our health undermined, our water polluted, endangered species threatened, the ozone layer destroyed, and our climate altered. The assault has already begun.

The purpose of this report is to give a general overview of the environmental threats associated with the wireless revolution, and an in-depth review of 70 years of research into the health hazards of microwaves.

The lack of an adequate review of the literature until now has led to the incorrect perception that the scientific evidence is contradictory and inconclusive. In fact the scientific evidence is consistent and overwhelming.

### Satellite systems

In 1957 there were no artificial satellites in the sky above us. Today there are thousands. The list of countries that have launched satellites to date is huge: the United States, Canada, Mexico, Brazil, Argentina, France, Germany, Norway, Sweden, Spain, England, Russia, Turkey, China, Japan, Indonesia, India, Thailand, Korea, Malaysia, Australia, New Zealand, Tonga, the European Community, Eastern Europe, the Arab League, Pan-Asia, and Intelsat (125 nations). Multinational corporations are sending up fleets. Even small private entrepreneurs are filling up the heavens with smaller, cheaper hardware. Whether a cellular phone company wants to provide global service, or a rancher in Australia wants to know the whereabouts of his cows, satellite technology will do the trick.

Ground based towers

The existing network of ground based antenna systems is not good enough. The telecommunications industry says it will need 270,000 more facilities immediately just in the United States (Microwave News, May/June 1996, p. 10), and comparable numbers elsewhere in the world. These are going up on lampposts and apartment buildings in cities, and on fresh eyesores throughout the suburbs, countryside and wilderness.

In addition, satellite systems, which shine very weakly on us, need to communicate with their own network of powerful earth stations. These stations will proliferate along with the satellites.

Pandora's box

Until recently almost all radio transmitters have been fixed and their range limited. The addition of more broadcast channels and new types of communication devices did not change that. But with the advent of cellular technology, all limits have been lifted. Telephones are no longer just communicators but also transmitters, and they are mobile. Suddenly every human being is a potential source of radiation. Suddenly electronic communication is a human right. Suddenly fixed transmitters and satellites are being built to accommodate mobile human beings, rather than the other way around.

Electromagnetic pollution will no longer remain concentrated in population centers, nor will radio transmitters be confined any longer to non-residential zones. In the space of a year or two, unless the people put a stop to it, this form of pollution will be spread more or less evenly over every square inch of the world.

### 3 Microwaving Our Planet

#### The power is small, but the reach is unlimited

There are among us today television towers that broadcast with a radiated power of 5 million watts. How much damage could the radiation from cellular equipment do by comparison? one might ask. Each antenna on a rooftop or tower generally emits less than 1000 watts, with 150 watts being the norm for lampposts and the sides of buildings.

The answer is surprising. If you live 10 miles from a 5 million watt television station, you will receive more radiation from a cellular antenna that is on a lamppost a block away than you will from that TV station. And by U.S. law, a 5 million watt TV station must be separated from other stations of similar frequency by a distance of at least 175 miles. Cellular transmitters are far less restricted: they can and will proliferate without limit. And they can and will increase their broadcast power if it is profitable to do so. The new legal limit is 3500 watts per channel per transmitting station, with no limit at all on the number of channels or the number of towers or the number of companies broadcasting in the same area.

Television signals also do not reach beyond line-of-sight from the tower, and are blocked by hills and buildings. The cellular transmitter is going to be right there where you are, anywhere on earth. You are no longer going to have the option of limiting your radiation exposure by living distant from antennas.

#### Health hazards

Microwave radiation is dangerous. As everyone knows, high levels will cook you. Low levels will also harm you in other ways.

Another type of radiation--that coming from electric power lines--has been much more in the news in previous



years. There is now a growing scientific consensus that the 60-cycle radiation from power lines is dangerous and can cause cancer, leukemia and other diseases. Fortunately the distribution of electricity is not yet wireless, and most of the earth's surface is still remote from high-tension wires.

Power line radiation (50 or 60 cycles per second, or hertz) is especially harmful because it is close to the frequency of brain waves. Microwave radiation is especially harmful because the wavelengths are smaller than our bodies. This radiation is therefore selectively absorbed by our bodies.

Table 1

	<u>maximum frequency</u> (Hz)	<u>wavelength</u>
power lines	60	3000 mi.
AM radio	1,600	600 ft.
short wave radio	30,000,000	30 ft.
FM radio	108,000,000	10 ft.
TV channels 2-13	216,000,000	5 ft.
TV channels 14-69	806,000,000	1 ft.
cellular phones	947,000,000	1 ft.
PCS	2,400,000,000	6 in.
satellites	50,000,000,000	$\frac{1}{4}$ in.

## 5 Microwaving Our Planet

Smaller waves are better absorbed by smaller body parts and smaller people (children).

Cellular transmitters are not only going to be more common than any transmitters have ever been before, they are also broadcasting at the most dangerous frequencies.

And this radiation will be doubly dangerous because all the new technology is going to be digital. Digital signals come in pulses, rather than continuously as is now the case, and pulsed radiation has been found by most investigators to be more injurious to living things at lower average levels of power than continuous radiation.

### Government safety standards

In the United States the Federal Communications Commission has set standards of permissible irradiation of the general public. These standards are based on thermal hazards only, the assumption being that if microwaves aren't strong enough to cook you, they will do you no harm. For cellular telephone systems, exposure is permitted to power densities of 533 to 1000  $\mu\text{W}/\text{cm}^2$  (microwatts per square centimeter), depending on the frequency. These standards are at least ten million times the level which probably still exists over most of the surface of the earth, and at least ten billion times the level of microwaves we receive naturally from the sun and stars. They are also at least two hundred thousand times greater than what even most city residents have been exposed to until very recently (Tell and Mantiply 1980, Solon 1979, Zaret 1974, Szmigielski and Gil 1989).

**Table 2: Exposure levels (uW/cm<sup>2</sup>)**

average stellar signal	.000000000000000000000001
cosmic radiation, 10 MHz	.00000000000000000008
from a quiet sun, all freq.	.0000000001
from one cellular satellite	.0000001
in Tottenville, N.Y.C. 1978	.000068
average New York City 1979	.002
300 ft. from a cellular tower	5.0
in Empire State Building 1978	32.5
in Sears Tower 1978	65.7
F.C.C. Safety Standard 1996	1000.0

We can reasonably expect the radiation levels over most of the habitable parts of the earth to increase 1000-fold just as a beginning result of the current cellular expansion. How high those levels eventually will go is anybody's guess.

The danger, even if we didn't have epidemiological studies, is evident. We cannot expect to increase the irradiation of the entire earth 1000-fold or more virtually overnight without health effects and without massive biological consequences. Indeed this technology is more invasive than virtually any other and has the potential of causing worldwide catastrophe.

## Review of the literature

The scientific literature is full of thousands of studies of the health effects of microwaves at power levels of 1-10 mW/cm<sup>2</sup>. I will not review those here. Supposedly those levels of exposure are not enough to cause heating of the body, yet the defenders of the 1 mW/cm<sup>2</sup> (1000 uW/cm<sup>2</sup>) safety standard dismiss any effects shown at those levels as heating effects. The absurdity of their position seems to escape them. But I will bypass their entire argument by only reviewing studies that show health effects at exposure levels of 500 uW/cm<sup>2</sup> or less--all the way down to .0000000026 uW/cm<sup>2</sup>.

Contrary to general belief, this body of literature is consistent and not contradictory. Microwaves impact most obviously the nervous system and the heart. There is generally not a linear dose-response effect, and there is not a threshold below which there is no effect. An effect seen at low intensity will not necessarily be seen at high intensity, nor vice versa. Because the impact is cumulative, short-term experiments will not give the same results as long-term experiments. Often more than one type of effect will be seen in the same group of experimental subjects; therefore averaging the results may lose information. In light of all this, the kinds of studies that are doomed to obtain negative findings are those done at high intensities, short term, looking for thresholds and linear dose-responses, and averaging all their data. In this is consistency also.

Some of the early animal experiments have been criticized because metal objects near the animals may have distorted the field and increased their radiation dose beyond what was reported. However, the more recent work (since the mid 1970s)

has all been done in carefully shielded enclosures with no metal wires or objects, and has produced the same results. In any case, what we are trying to gauge here is the effect on human health, and none of us live in shielded houses devoid of wires or metal objects. The earliest research is therefore just as relevant to the human situation as the most recent, if not more so.

### 1. The nervous system

Radiation sickness. Symptoms that may occur include headache, fatigue, weakness, sleep disturbances, irritability, dizziness, memory difficulty, emotional instability, depression, anxiety, sexual disorders, skin markings, rash, burning sensation in the face, acrocyanosis (blue fingers and toes), sweating, tremors, accentuated tendon reflexes, decreased abdominal reflexes, unequal pupil size, and unstable pulse and blood pressure. These symptoms were consistently found in controlled studies of workers exposed to various frequencies of microwaves on the job, by:

Sadchikova (1960) in a clinical study of 525 workers exposed to microwave generating equipment. Those exposed to hundreds of microwatts per square centimeter or less had symptoms more often than those exposed to higher intensities.

Sadchikova (1974) in a clinical study of 1180 workers. Here too those exposed to lower intensities had more frequent symptoms than those exposed to higher intensities. Certain types of changes, for example hypotension and bradycardia, were more frequent at high intensities.

Klimkova-Deutschova (1974) in a clinical study of 530 workers from 29 places of employment.

Baranski and Edelwejn (1975) in a study of workers in the Military Institute of Aviation Medicine, Warsaw.

Zalyubovskaya and Kiselev (1978) in a clinical study of 72 engineers and technicians.

Bachurin (1979) in a clinical study of 100 television, radio, and other workers exposed to 20-60  $\mu\text{W}/\text{cm}^2$  and up to 100  $\mu\text{W}/\text{cm}^2$  on occasion. Photophobia was also noted in an occasional worker.

Sadchikova et al. (1980) in a clinical study of 50 industrial workers exposed to several hundred  $\mu\text{W}/\text{cm}^2$ .

Huai (1981) in a clinical study of 841 workers in 11 factories and institutes, including 238 people exposed to less than 50  $\mu\text{W}/\text{cm}^2$ .

Gorbach (1982) in a clinical study of 142 workers exposed to microwave equipment.

Trinos (1982) in a clinical study of 2247 workers at 2 industrial plants.

Markarov et al. (1995), in a clinical study of 53 workers exposed to regular low-dose radiation.

Several cases of psychosis have been described in workers with objective signs of radiation sickness. These patients developed symptoms of mania and paranoia that did not fit the pattern for schizophrenia and were treatable only by removal from exposure to radio waves (Chudnovskiy et al. 1979).

Baranski and Czerski (1976) wrote, "The pathogenesis of these syndromes may be controversial but their existence cannot be denied. Similar observations were made by Miro in France, and in the United Kingdom and the United States, according to a personal communication made by Mumford to Seth and Michaelson" (p. 168).

Sensory thresholds. Bourgeois (1967), in an experiment with 36 young men 18-25 years of age, found that a two-minute exposure to 500  $\mu\text{W}/\text{cm}^2$  of 1000 MHz radiation significantly lowered their auditory threshold, i.e. made them more sensitive to sound. Both continuous and amplitude modulated waves had this effect.

Lobanova and Gordon (1960), in a clinical study of 358 workers 20-35 years of age occupationally exposed to low-level microwaves, found that a majority had either abnormally

high or, more often, abnormally low sensitivity to odors. A change in olfactory sensitivity was found to be one of the earliest signs of microwave influence.

Baranski and Czerski (1976) review several studies which show that chronic microwave exposure also decreases auditory, visual, and skin sensitivity, both clinically and in EEG studies.

EEG. Changes in the electroencephalogram show a generalized inhibition of the central nervous system as well as certain specific pathological patterns.

In addition to general inhibition, Klimkova-Deutschova (1974) found small but specific changes in the EEG of many workers exposed to microwaves in the 3-13 centimeter band. This included synchronized slow waves of high amplitude, similar to those seen in epileptic seizures. The EEG was said to be an important diagnostic tool that objectively shows microwave effects even when clinical signs are only slight.

Baranski and Edelwejn (1975) reported that workers with the longest occupational exposure to microwaves generally exhibit flat EEG recordings.

Huai (1981), in an examination of 106 microwave-exposed workers, found an increase in slow (theta and delta) waves on their EEG.

Mann and Roschke (1996) exposed 14 healthy male volunteers 21-34 years of age to a digital cellular phone during the night at a distance of 40 cm., so that the power density reaching their head was  $50 \text{ uW/cm}^2$ . Specific alterations in their EEG were noted. The radiation also caused a significant decrease in the amount of REM sleep.

Sikorski and Bielski (1996) found abnormal glucose tolerance tests in 31 of 50 workers exposed to radio waves. Of these, 10 also had abnormal EEGs.

## 11 Microwaving Our Planet

Experiments on animals. Acute low-level exposure to microwaves stimulates the nervous system, while chronic exposure suppresses it. This has been confirmed in animals by behavioral changes, EEG changes, lowered levels of neurotransmitters, lowered levels of the respiratory enzyme cytochrome oxidase, and cell damage as seen in the electron microscope.

Gvozdkova et al. (1964) exposed groups of chinchilla rabbits to 12.5 cm., 52 cm., and 1 m. radiation for 5 minutes. 81% showed changes in the EEG when exposed to  $20 \text{ uW/cm}^2$ .

Frey (1967) induced evoked potentials in the brain stem of cats with pulsed 1200-1525 MHz waves at an average power density of  $30 \text{ uW/cm}^2$ .

Giarola et al. (1971) observed a tranquilizing effect on chickens and rats at  $24 \text{ uW/cm}^2$  using 880 MHz waves.

Dumanskij and Shandala (1974) irradiated 228 white rats and 60 rabbits, 8-12 hours a day for 120 days. Inhibition of conditioned reflexes was produced by 6 meter waves at  $1.9 \text{ uW/cm}^2$ , and by 3 centimeter waves at  $5 \text{ uW/cm}^2$ . Definite EEG changes were noted even at  $0.06 \text{ uW/cm}^2$  for the 6 meter waves: an initial excitation of the nervous system gave way to synchronized rhythms and then to general inhibition during the course of the experiment. "Electromagnetic energy in the UHF range and  $0.06\text{-}10 \text{ uW/cm}^2$  intensity . . . was indeed active biologically according to the results of statistical analysis" (p. 291). Other indicators of nervous system activity--cholinesterase and sulfhydryl groups in the blood--were also significantly lowered at  $1.9 \text{ uW/cm}^2$ .

Gabovich et al. (1979) found that  $100 \text{ uW/cm}^2$  for 2 hours a day first increased the work capacity of rats and later decreased it. It also affected the latent period of unconditioned reflexes, altered sleep, and lowered cholinesterase activity in the blood and the brain. The frequency was 2375 MHz, continuous mode.



Grin' (1978) found that  $50 \text{ uW/cm}^2$  increased epinephrine, norepinephrine, and dopamine in the brain of rats after 7 hours a day exposure for a month. The wavelength was 12.6 cm.  $500 \text{ uW/cm}^2$  decreased the levels, and exhausted the adreno-sympathetic system.

Dumanskiy and Tomashevskaya (1978) found a 20-26% decrease in cytochrome oxidase, a respiratory enzyme, in brain mitochondria, after 4 months exposure of rats. The frequency was 2375 MHz, continuous wave, and the power was  $100 \text{ uW/cm}^2$ . Another enzyme, glucose-6-phosphate dehydrogenase (G-6-PDH), rose 20-28% in compensation.

In a 4-month experiment with 1200 albino rats, Dumanskiy et al. (1982) found an increased skin sensitivity to electrical stimulation, decreased work capacity and altered conditioned reflexes at  $25\text{-}60 \text{ uW/cm}^2$ .  $40 \text{ uW/cm}^2$  activated blood cholinesterase, while  $115 \text{ uW/cm}^2$  inhibited the enzyme. The wavelength was 3 cm.

Shandala et al. (1979) exposed rabbits to 2375 MHz waves for 7 hours a day for 3 months.  $10 \text{ uW/cm}^2$  stimulated the electrical activity of the brain.  $50 \text{ uW/cm}^2$  stimulated brain activity for 30 days, then gradually inhibited it. At  $500 \text{ uW/cm}^2$  inhibition began within 2 weeks. In rats,  $500 \text{ uW/cm}^2$  decreased behavioral search activity, suppressed the food response, and decreased work capacity.  $10 \text{ uW/cm}^2$  and  $50 \text{ uW/cm}^2$  had the same suppressive effect on the nervous system after 30 days, and increased the sensitivity of the skin to electrical irritation.

Shutenko et al. (1981) exposed rats to 2375 MHz waves for 2 hours a day for 10 weeks.  $10 \text{ uW/cm}^2$  inhibited unconditioned reflexes, and lowered cholinesterase in blood and brain tissue.

Belokrinitiski (1982a) found an increase in the activity of the enzymes succinate dehydrogenase (SDH), malate dehydrogenase (MDH), lactate dehydrogenase (LDH), and G-6-PDH,